POSSIBILITIES OF IMPROVING MOBILITY THROUGH IMPLEMENTATION OF FUNCTIONAL BICYCLE NETWORK IN THE CITY OF ZAGREB

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ABSTRACT

The increase in population coupled with a rise in living standard has caused a growth in migration within and outside urban areas. The major problems facing cities today are related to public and private traffic. The traffic system limitations and excessive mobility of the population leads to traffic congestion, air and environment pollution, and other negative impacts. The necessity of mobility and social imperative in form of sustainable development has led to the reconciliation of these two opposite objectives. Like many European cities, City of Zagreb faces similar problems regarding traffic. One way to partly reduce negative traffic impacts is to develop functional bicycle network to provide foundation for development of greener mobility. This article proposes a detailed analysis of the current state of bicycle traffic in Zagreb along with the necessary infrastructural improvements that can be easily adapted to Zagreb and to other European cities.

Key words: bicycle network, green mobility, traffic congestion, air pollution
POSSIBILITIES OF IMPROVING MOBILITY THROUGH IMPLEMENTATION OF FUNCTIONAL BICYCLE NETWORK IN THE CITY OF ZAGREB

1. INTRODUCTION

The city is larger or smaller, dense and permanent, closed agglomeration, which implies the existence of active life relations and in external appearance, reflects the high degree of organization. From the traffic point of view, cities have through all history been the most important world transportation hubs and on those intersections of important transport and trade routes, major cities have developed.

Given that cities are located on the intersections of important transport and trade routes, and because they represent the economic, social and cultural centers, they attract population. The percentage of urban population is continuously increasing and according to the United Nations it is estimated that 60% of population will reside in cities by the year 2030. In Europe, it is estimated that proportion of the population residing in urban areas will increase from 72% in 2007 to 84% in 2050\(^1\).

With the growth living standards, the need for migration within and outside urban areas is rising. One of the biggest problems facing most urban areas is a certain degree of insufficient transport systems, both public and private. The shortcoming of the transport system and excessive mobility leads to traffic congestion, air and environment pollution and a number of other negative consequences. The necessity of mobility and social imperative in form of sustainable development has led to the reconciliation of these two opposite objectives.

Analysis of urban mobility showed a worrying trend of excessive car use for short journeys in urban areas. In Europe, more than 30% of car travelling distances are less than 3 km and 50% are less than 5 km\(^2\).

Travelling distances of mentioned categories can be covered with bicycle within 15 to 20 minutes, and as opposed to passenger cars, bicycle is almost perfect solution for short urban journeys. Considering all its advantages bicycling can be an effective solution for part of problems regarding urban transport. Therefore, cities must develop and encourage the development of cycling to ensure sustainability of urban transport.

This paper focuses on analysis current bicycle traffic the in City of Zagreb. Based on the analysis, measures for infrastructural improvements of bicycle transport are proposed.


\(^2\) http://www.europa.eu.int/comm/environment/cycling/cycling_en.htm (03.03.2014.)
POSSIBILITIES OF IMPROVING MOBILITY THROUGH IMPLEMENTATION OF FUNCTIONAL BICYCLE NETWORK IN THE CITY OF ZAGREB

2. THE ROLE OF BICYCLE TRANSPORT IN URBAN AREAS

Looking from the community viewpoint, the problems caused by the increased car use are very serious. Problems are related to the loss of urban space, energy consumption and environment pollution. In addition to the air, water and land pollution, motorized traffic produces noise and the consequences of road accidents and congestion are the real problems of cities today.

When considering an alternative to cars in urban areas, public transport is usually first choice. However, public transport is not the only alternative. As mentioned before, in Europe, more than 30% of car travelling distances less than 3 km and 50% are less than 5 km which can be covered with bicycle within 15 to 20 minutes. In these distances (up to 5 km even more in the case of congestions) bicycles are faster than cars. Furthermore, they do not pollute the environment, are quiet, economical and accessible to use for different generations. Although bicycle transport is not the only solution to traffic and environmental problems in urban areas, it represents a solution which fits perfectly into today’s trend of sustainable development.

In general it can be said that the main benefits of increasing bicycle transport in urban areas, and therefore the main arguments for its development are:

- economic benefits (such as a drop in the share of the household budget devoted to the car, reduction of working hours lost in traffic jams, reduction of health costs thanks to the effects of regular exercise)
- political advantages (such as a reduction in dependence on energy, saving non-renewable resources)
- social advances (such as the democratization of mobility, greater autonomy and accessibility of all facilities to both young and elderly people)
- ecological impacts (with a distinction between local, short-term effects — notion of the environment — and non-localized long-term effects — notion of ecological balance).

Main advantages are related to the ecological impacts. As shown in the Table 1., bicycle transport has the least primary energy consumption and air pollutions as well as the percentage of space consumption.

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POSSIBILITIES OF IMPROVING MOBILITY THROUGH IMPLEMENTATION OF FUNCTIONAL BICYCLE NETWORK IN THE CITY OF ZAGREB

Table 1. Comparison of various transport modes from the ecological viewpoint

<table>
<thead>
<tr>
<th></th>
<th>Car</th>
<th>Bus</th>
<th>Train</th>
<th>Bicycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space consumption</td>
<td>100</td>
<td>10</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Primary energy consumption</td>
<td>100</td>
<td>30</td>
<td>34</td>
<td>0</td>
</tr>
<tr>
<td>CO2</td>
<td>100</td>
<td>29</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Nitrogen oxides</td>
<td>100</td>
<td>9</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Risk of accidents</td>
<td>100</td>
<td>9</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: Marsh, P.C., Ritzau-Kjaerulff, T.: Barriers to the Creation of a Bike-City, 2012

As far as urban areas are concerned, the advantages of the bicycle for the community are mainly linked to the quality of life and environment and to long-term savings made through the following:

- a direct reduction in traffic hold-ups through the falling number of cars in circulation
- an indirect reduction in traffic hold-ups through the increased appeal of public transport for commuters thanks to a combination of public transport and bicycle
- better fluidity of traffic, which is indispensable, with a lower pollution level
- space savings (on the road and in parking areas) and hence a reduction in investments in roadways and the possibility of making a different use of public space in order to increase the attractiveness of city centers
- a general improvement to the quality of life in cities (air pollution, sound pollution, public places, children’s safety)
- less severe deterioration of historical monuments and reduced maintenance costs (less frequent cleaning, for example).

Despite the benefits of bicycle transport in urban areas, its acceptance depends largely on subjective and objective factors. Subjective factors include: image, social acceptability, a sense of security, understanding of transport problems in urban areas, the financial power of citizens, etc., while the objective factors include: the topography of the urban environment,

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5 Marsh, P.C., Ritzau-Kjaerulff, T.: Barriers to the Creation of a Bike-City, 2012
POSSIBILITIES OF IMPROVING MOBILITY THROUGH IMPLEMENTATION OF FUNCTIONAL BICYCLE NETWORK IN THE CITY OF ZAGREB

the climate, the existence of bike paths, general safety, etc.. In general it can be said that there are three main obstacles in the development of bicycle transport⁶:

a) perception and awareness
b) space (or lack of it)
c) policy

From the above it can be concluded that for the realization of potential uses and benefits of bicycle transport basic conditions for the development of bicycle transport must be ensured. Measures for improvement of bicycle transport include the implementation of bicycle lines, construction of parking spaces, development of bicycle network, development of the bicycle rental system, traffic calming measures, education of all participants in traffic, police involvement in strict observance of the law and integration with other modes of transport.

3. POSSIBILITIES OF IMPROVING BICYCLE NETWORK IN CITY OF ZAGREB

As City of Zagreb is medium-sized European city with limited possibilities for further motorized traffic development, especially in the older parts, alternative solution in the form of bicycle transport is necessary. In this chapter current state and possible improvements of bicycle transport in the City of Zagreb will be analyzed and presented.

3.1. Current state of bicycle transport in the City of Zagreb

The first bicycle line in the City of Zagreb is derived in 1995. for recreational purposes. Until now about 200 km of bicycle lines and paths have been implemented along the 430 installed racks for parking purposes.

Figure 1. shows current the map of City of Zagreb with highlighted existing bicycle lines. From figure 1. one can conclude that most of the existing bicycle lines are not connected and do not form well-designed and meaningful bicycle network.

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⁶ Marsh, P.C., Ritzau-Kjaerulff, T.: Barriers to the Creation of a Bike-City, 2012
POSSIBILITIES OF IMPROVING MOBILITY THROUGH IMPLEMENTATION OF FUNCTIONAL BICYCLE NETWORK IN THE CITY OF ZAGREB

Figure 1. Current bicycle lines and paths in the City of Zagreb


Due to the fact that, in City of Zagreb, attention to the bicycle transport has been given only in the past twenty years, the quality of infrastructure is not at satisfying level. Although in all newly constructed roads bicycle lines are implemented, often they are not physically connected with the existing ones, not properly maintained or executed and do not provide a safe and comfortable ride.

Figure 2. Examples of improperly maintained (left) and executed (right) bicycle lines in the City of Zagreb

POSSIBILITIES OF IMPROVING MOBILITY THROUGH IMPLEMENTATION OF FUNCTIONAL BICYCLE NETWORK IN THE CITY OF ZAGREB

During the analysis of the current state of bicycle transport in the City of Zagreb, the following deficiencies were registered:

- non-existence of well-designed bicycle network
- existing bicycle lines are not maintained and/or are poorly executed
- non-existence of parking spaces
- inadequate system of public bicycles
- legislation is not well adapted to the needs and conditions of today.

3.2. Measures for improvement of bicycle transport in the City of Zagreb

The share of bicycle transport in the trip structure in the City of Zagreb is not enough and precise analyzed and depending on the authors (Ordulj, A., Civitas Elan) it is between 1 to 3%. Since one of the goals of Cities’ transport development is the development of bicycle transport it can be concluded that the proportion of bicycle transport will grow. The growth of bicycle transport requires improving in the bicycle transport system.

Generally, improvements can be divided into three groups of measures:

1) measures related to infrastructure
2) measures related to legislation
3) measures related to education and promotion

This paper focuses on the infrastructural measures which include implementation of new bicycle lines, linking existing and new lines in a meaningful network, connecting the city with surrounding areas (suburbs), maintenance of existing lines and building parking spaces connected to the bicycle network.

Proposed infrastructural measures for the City of Zagreb are as followed:

a) development of bicycle highway
b) implementation of new and better maintenance of existing bicycle lines
c) development of parking facilities and spaces

a) Development of bicycle highway

The development of bicycle highway would allow, in cycling terms, quality and safe connection of the City of Zagreb and its surroundings (Velika Gorica, Zaprešić, Samobor, Dugo Selo, Rugvica, etc.). As City of Zagreb represents largest economic, cultural and social center of Republic of Croatia, it is logical that a large number of people living in its suburbs travel to the City every day.
POSSIBILITIES OF IMPROVING MOBILITY THROUGH IMPLEMENTATION OF FUNCTIONAL BICYCLE NEWTWORK IN THE CITY OF ZAGREB

The main bicycle highways would link northern and southern and western and eastern parts of the City as well as other areas that make up the suburbs. Also, bicycle highways would form backbone of bicycle network on which existing and new lines would connect enabling the future expanding and development of bicycle culture in Zagreb. Besides traffic, highways function would also be development of cycling tourism and recreation.

Figure 3. shows major bicycle highways on which other bicycle lines are connected.

![Proposed bicycle highways in the City of Zagreb](image)


b) Implementation of new and better maintenance of existing bicycle lines

Performing new and maintain existing bicycle lines is one of the basic measures for the development of bicycle transport. Currently, in the City of Zagreb, new bicycle lines are implemented at slow rate. However, the possibilities for improvement are significant.

One possible solution is to implement bicycle lines along the creek Vrapčak with the length of 5.5 km that extends through the highly urbanized western part of the City. Bicycle line can be constructed as a separate or within walking paths connecting western part of the city (Špansko, Malešnica, Rudeš, etc.) with a recreational zone along the river Sava creating a paths that would efficiently connect two parts of the city and providing divers recreational opportunities.
Another possible solution is the conversion of traffic surface on streets Dure Deželića which would be an integral part of the bicycle highway Zaprešić - Sesvete.

A possible solution for Dure Deželića street is based on reducing traffic area for motorized traffic and conversion into bicycle. So instead of three motorized traffic lines two would be implemented and the rest of area would be bicycle line with width of 2.4 meters.

c) Development of parking facilities and spaces

Bicycle parking’s are one of the basic elements of the bicycle transport development. Many European cities with highly developed bicycle transport, like Amsterdam and Copenhagen) have major problems with bicycles parked in public areas and streets.

Parking facilities or spaces for bicycles, in the City of Zagreb, should be implemented at all major city destinations such as hospitals, schools, universities, turnarounds of public transport, sports-recreational areas etc.. Basic requirements for bicycle parking are:

- visibility and availability
- security
- ease of use and
- connection with other needs of cyclists.

These requirements must be taken into consideration during the planning and implementing new bicycle lines as well as new parking spaces for bicycles.

4. CONCLUSION

Looking from the community viewpoint, the problems caused by the increased car use are very serious. Problems are related to the loss of urban space, energy consumption and environment pollution. In addition to the air, water and land pollution, motorized traffic produces noise and the consequences of road accidents and congestion are the real problems of cities today.

Efficient way to reduce those negative effects is by developing bicycle transport which does not pollute the environment and is quiet, economical and accessible to use for different generations.

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POSSIBILITIES OF IMPROVING MOBILITY THROUGH IMPLEMENTATION OF FUNCTIONAL BICYCLE NETWORK IN THE CITY OF ZAGREB

Generally, it can be said that the main benefits of increasing bicycle transport in urban areas, and therefore the main arguments for its development are:

- economic benefits
- political advantages
- social advances
- ecological impacts

Despite the benefits of bicycle transport in urban areas, its acceptance depends largely on subjective and objective factors. In general, there are three main obstacles in the development of bicycle transport: perception and awareness, space (or lack of it) and policy.

In the City of Zagreb, only in the least twenty years attention has been given to the bicycle transport. In this short period, some progress has been made but the progress and development is to slow (share of bicycle transport in the City of Zagreb is between 1% and 3%) compare to other similar sized European cities. In Amsterdam, bicycle transport has grown by more than 40%8 in the last 20 years and in Copenhagen share of bicycle transport in total transport is 32%9.

Analyzing the current state of bicycle transport in the City of Zagreb, it can be concluded that main problems are as followed:

- non-existence of well-designed bicycle network
- existing bicycle lines are not maintained and/or are poorly executed
- non-existence of parking spaces
- inadequate system of public bicycles

In order to eliminate insufficiencies of bicycle transport in the City of Zagreb, improvements regarding the infrastructure, legislation and education and promotion must be implemented. This paper analyzed infrastructural measures which include implementation of new bicycle lines, linking existing and new lines in a meaningful network, connecting the city with surrounding areas (suburbs), maintenance of existing lines and building parking spaces connected to the bicycle network.

Proposed infrastructural measures relate to the development of bicycle highway which would allow, in cycling terms, quality and safe connection of the City of Zagreb and its

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8 http://www.iamsterdam.com/amsterdam%20cycling%20measures (05.03.2014.)
9 http://www.fietsberaad.nl/library/repository/bestanden/Fietsberaad_Publicatie7A.pdf (05.03.2014.)
POSSIBILITIES OF IMPROVING MOBILITY THROUGH IMPLEMENTATION OF FUNCTIONAL BICYCLE NETWORK IN THE CITY OF ZAGREB

surroundings (Velika Gorica, Zaprešića, Samobor, Dugo Selo, etc.), implementation of new and better maintenance of existing bicycle lines and development of parking facilities and spaces.

For effective implementation of these measures, City of Zagreb must develop progressive bicycle transport strategy which would cover all the elements of bicycle transport.

5. LITERATURE